Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Promoting More Efficient Use of Spectrum	)	ET Docket No. 10-237
Through Dynamic Spectrum Use Technologies	)	

COMMENTS OF AT&T INC.

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EXECUTIVE SUMMARY

As Chairman Genachowski has correctly noted, "[s]pectrum is the oxygen of our mobile networks," and "the biggest threat to the future of mobile in America is the looming spectrum crisis." Wireless providers are constantly experimenting and upgrading their networks in order to meet the explosive demand for wireless broadband services, yet further steps must to be taken if the projected continued growth is to be accommodated. AT&T shares the Commission's commitment to exploring any innovative techniques and technologies that have the potential to enhance the efficiency of spectrum use. While AT&T recognizes that dynamic spectrum use technologies hold great promise, AT&T cautions the Commission that these techniques are wholly inappropriate for introduction to the licensed mobile bands, except where closely coordinated and controlled by the incumbent licensee.

The licensed mobile bands are among the most heavily and efficiently used spectrum bands in the U.S., and are relied upon by public safety, utilities, the medical industry, and hundreds of millions of U.S. consumers. Introduction of dynamic spectrum use technologies outside of the control and coordination of the licensee could upset the innovation-driving balance established by the confluence of flexible use licensing, the Commission's secondary markets rules, and robust competition in the wireless market. Substantial incentives already exist to put licensed mobile spectrum to the fullest possible use, and it is unlikely that adding dynamic spectrum use techniques would bring significant benefits. Additionally, dynamic spectrum use technologies are technically unsuited for the licensed mobile bands, which are constantly changing and are characterized by an extremely large number of low power transmitters and sensitive receivers with unpredictable usage patterns. Moreover, because of the increased uncertainty and heightened potential for interference, introduction of dynamic spectrum use

techniques could decrease the value of existing licensed mobile spectrum rights, potentially exposing the Commission to legal challenges and hindering the ongoing deployment of mobile broadband services.

Rather than exploring the introduction of dynamic spectrum use technologies to the licensed mobile bands through regulatory fiat, the Commission should recognize that significant and promising alternatives exist that would permit the deployment of these devices without threatening critical communications services. The spectrum resources currently available for unlicensed and non-exclusive uses dwarf the amount of spectrum dedicated for licensed mobile services, and the Commission should focus first on these opportunities—some of which are relatively underutilized. Furthermore, to the extent that opportunities for more efficient use do exist, Commission policies already enable potential dynamic users to negotiate with licensed mobile and Federal spectrum holders to gain access.

The threat posed to licensed mobile services by unauthorized dynamic devices is severe, and is made more so by the fact that interfering devices could be extremely difficult to identify and prevent. AT&T is particularly concerned about the potential for end-user modification of policy radios in ways that could cause significant harmful interference to critical communications services. In light of these serious risks, the Commission should take great care in considering policies and actions directed at expanding deployment of dynamic spectrum use devices. Under no circumstances should these devices be permitted to operate in the licensed mobile bands except under the close control and coordination of the exclusive licensee.

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AT&T Inc. ("AT&T") hereby submits the following comments in response to the Federal Communications Commission's ("Commission") Notice of Inquiry ("Notice") on dynamic spectrum access technologies.[1]

I. INTRODUCTION

AT&T shares the Commission's desire, underlying the present Notice, to "undertake long-term spectrum planning" and to "ensure that any available spectrum is used as efficiently and productively as possible."[2] The need to maximize the efficiency of existing spectrum resources and identify additional mobile broadband spectrum are crucial, and the Commission's National Broadband Plan appropriately set aggressive goals in this area. AT&T strongly concurs with Chairman Genachowski's observations that "[s]pectrum is the oxygen of our mobile networks," and that "the biggest threat to the future of mobile in America is the looming spectrum crisis."[3] Indeed, as AT&T has previously noted, commercial wireless networks are

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1 Promoting More Efficient Use of Spectrum Through Dynamic Spectrum use Technologies, ET Docket No. 10-237, *Notice of Inquiry*, 25 FCC Rcd 16632 (2010).

2 *Id.*, 25 FCC Rcd at 16632 ¶ 1.

3 Prepared Remarks of Chairman Julius Genachowski, Federal Communications Commission, "America's Mobile Broadband Future," International CTIA WIRELESS I.T. & Entertainment, San Diego, California (Oct. 7, 2009) at 4, *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-293891A1.pdf.

seeing explosive growth in usage, driven by widespread consumer adoption of innovative mobile broadband devices and services.[4]

As AT&T explained on the record in the National Broadband Plan proceeding, wireless data traffic has increased on its network by nearly 5,000 percent in recent years.[5] This trend is consistent industry-wide. For example, Cisco reports that global mobile data traffic grew 2.6-fold in 2010, nearly tripling for the third year in a row.[6] Consumers are using their devices in new ways, as is evidenced by Cisco's observation that mobile video traffic will exceed 50 percent for the first time in 2011.[7] Looking forward, Cisco predicts that global mobile data traffic will increase 26-fold between 2010 and 2015, reaching 6.3 exabytes per month by 2015.[8]

The exponential growth in mobile data traffic is attributable in part to the increasing popularity of emerging devices, which include smartphones and embedded computing devices such as tablets, netbooks, and laptops. The popularity of these devices is growing at an unprecedented rate. To illustrate, shipments of smartphones overtook those of personal computers for the first time ever in the fourth quarter of 2010.[9] Although currently substantially more people currently own PCs than own smartphones, research firm Frost & Sullivan forecasts

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4 *See, e.g.*, Comments of AT&T Inc., GN Docket No. 09-47, 09-51, 09-137 at 3-8 (filed Oct. 23, 2009) ("AT&T NBP PN # 6 Comments").

5 *Id.* at 7.

6 Cisco, *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010-2015* at 1 (Feb. 1, 2011) *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf.

7 *Id.*

8 *Id.* at 2.

9 *See* David Goldman, *Smartphones have conquered PCS*, CNNMoney.com, http://money.cnn.com/2011/02/09/technology/smartphones_eclipse_pcs/index.htm (Feb. 9, 2011).

that smartphone penetration in the U.S. will match that of PCs by 2015.[10] This growth is being driven by carrier infrastructure investment and implementation of the most efficient and advanced mobile broadband technologies. AT&T epitomizes this trend of technological investment and innovation. Although commercial wireless carriers work tirelessly to expand capacity and efficiency on their networks, further steps must to be taken to accommodate the projected continued growth in demand for mobile broadband services. However, in attempting to identify innovative solutions to the nation's urgent need for additional mobile spectrum, the Commission must be careful not to take any action that could inadvertently threaten the viability of the booming, yet still nascent, mobile broadband industry. As such, AT&T respectfully urges the Commission to recognize that dynamic spectrum technologies are fundamentally inappropriate for introduction into licensed spectrum bands except under the close control of the existing licensee.

Historically, commercial mobile providers have been highly efficient users of spectrum, constantly seeking out opportunities to improve their services as a means of stimulating and satisfying demand. The Commission's flexible use rules have freed the wireless industry to innovate and compete to the benefit of U.S. subscribers. Thanks in no small part to this flexibility, carriers are continually reengineering their networks by deploying new technologies. Thus, AT&T and others have been able to migrate from analog AMPS, to first generation digital TDMA, then to 2G GSM and EDGE and on to 3G UMTS-HSPA. Now, AT&T has upgraded its network to 4G speeds with HSPA+ and is embarking on yet another massive upgrade to LTE, all without the need for regulatory intervention.

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[10] *Id.*

While the Commission's flexible use policies provide the opportunity to innovate, the Commission's secondary markets rules provide the economic incentive to ensure that spectrum is being used to its fullest potential. These two policies combined obviate any need for the Commission to adopt rules specifically promoting dynamic spectrum use or cognitive radio technologies within exclusively licensed, commercial mobile spectrum bands. Indeed, AT&T and other network operators already employ cognitive radio techniques in their own networks. But while cognitive radio technology holds potential for allowing a network operator to maximize the value of its own spectrum resource, third parties, by contrast, have no incentive to maximize the efficiency and value of the network as a whole.

Against this backdrop of innovation, it is unsurprising that the Commission has previously rejected calls to permit "dynamic" or "shared" use of licensed bands. For example, in the interference temperature proceeding the Commission proposed "a fundamental paradigm shift in the Commission's approach to spectrum management by specifying a potentially more accurate measure of interference that takes into account the cumulative effects of all undesired RF energy."[11] The model was supposed to help identify opportunities for additional transmitters to operate in currently licensed bands, particularly unlicensed devices operating on an "underlay" basis.[12] Ultimately, the Commission terminated the proceeding without taking action on the proposals, noting that the "[c]ommenting parties generally argued that the interference temperature approach is not a workable concept and would result in increased interference in the

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[11] Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands, ET Docket No. 03-237, *Notice of Inquiry and Notice of Proposed Rulemaking*, 18 FCC Rcd 25309 ¶ 1 (2003).

[12] *See id.*, 18 FCC Rcd at 25315 ¶ 16.

frequency bands where it would be used."[13] Similarly, in the TV White Spaces proceeding, the Commission determined that "spectrum sensing" technology "would not, by itself, be sufficient to adequately protect from interference television and other licensed services that use the TV bands."[14]

AT&T understands that periodic re-evaluation of the state of technology may be in order. However, as discussed below, dynamic use of licensed mobile bands remains contrary to the public interest. In fact, AT&T submits that permitting uncoordinated dynamic use of licensed mobile spectrum bands could actually exacerbate the looming spectrum crisis by decreasing spectral efficiency, constraining incentives to deploy technology upgrades, and impacting the capital available for next generation broadband deployment. Moreover, ample opportunities exist for dynamic spectrum use devices to be deployed outside of existing commercial wireless spectrum bands. In particular, the Commission should consider the potential efficiencies to be gained through the deployment of dynamic spectrum use technologies in the unlicensed and Federal government spectrum bands. In light of the significant risks to licensed operations that these devices pose, the Commission should dismiss any consideration of their introduction to the licensed mobile bands, and should only engage very cautiously in any experimentation with these devices.

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[13] Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands, ET Docket No. 03-237, *Order*, 22 FCC Rcd 8938 (2007).

[14] Unlicensed Operation in the TV Broadcast Bands, ET Docket Nos 04-186, 02-380, *Second Report and Order and Memorandum Opinion and Order*, 23 FCC Rcd 16807, 16836 ¶ 73 (2008) ("2008 TV White Spaces Order").

II. DYNAMIC USE OF LICENSED MOBILE SPECTRUM BANDS WOULD BE CONTRARY TO PUBLIC POLICY.

In the Notice, the Commission seeks comment on what spectrum bands might be most appropriate for use of dynamic spectrum access techniques.[15] The Commission also expresses a belief that dynamic spectrum access radios "hold great potential for enabling a variety of new types of efficient and innovative spectrum sharing within spectrum bands already licensed under flexible use policies and rules."[16] AT&T concurs that dynamic spectrum use technologies hold promise and warrant further exploration. Indeed, AT&T Labs scientists and engineers continue to play a major role in research to address the many remaining technical challenges associated with cognitive radios and opportunistic spectrum use. However, AT&T stresses that these technologies are inappropriate for use in licensed mobile spectrum, except under the sole control of the licensee. And the proper place for continued development and experimentation of such unproven technologies is not in the commercial mobile spectrum relied upon by hospitals, first responders, utilities, homeland security, and more than 270 million consumers.

For a variety of reasons, the licensed commercial mobile frequencies are inappropriate for deployment of dynamic use technologies outside of the control of the licensee. As a practical and economic matter, use of these technologies in licensed spectrum is all but guaranteed to upset the highly efficient use made of such spectrum resources. Moreover, as a technical matter, the heavily-populated licensed mobile bands present something approaching a worst-case scenario for the deployment of dynamic use techniques. Finally, because of the potential devaluation of auctioned spectrum, introduction of dynamic use technologies in the licensed mobile bands could potentially expose the Commission to serious legal challenges.

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15 *See* Notice, 25 FCC Rcd at 16647 ¶ 43.

16 *Id.*, 25 FCC Rcd at 16644 ¶ 36.

A. Uncoordinated Dynamic Use Threatens the Efficiency of Licensed Mobile Spectrum.

Unless their operations are closely coordinated by the licensee, dynamic use technologies threaten the remarkable efficiency of the licensed mobile spectrum bands, which is promoted by key Commission policies and robust competition. The Commission's flexible use rules and liberal secondary markets policies create tremendous incentives for carriers to make the most efficient use of their spectrum in the highly competitive mobile broadband marketplace. Because of the variety of means by which carriers can exploit their substantial spectrum investments, there are likely few opportunities for dynamic spectrum use to rationalize underused spectrum resources in these bands. Instead, introduction of these technologies in the licensed mobile bands is more likely to upset the powerful incentives that currently drive innovation in the sector.

The Commission's flexible use rules have fueled innovation and experimentation by providing regulatory certainty for licensees to launch any service and pursue any business model for which they identify a market. Flexible use helps ensure that the latest technologies are brought to market, and that the industry is constantly able to respond to shifts in consumer demand. These policies have facilitated pro-consumer collaborations by providing the flexibility for equipment manufacturers, carriers and others jointly to develop and provide telemedicine services,[17] Smart Grid applications,[18] integrated navigation services,[19] netbooks,[20] e-readers,[21] tablets,[22] and innovative machine-to-machine offerings.[23]

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[17] *See, e.g.*, AT&T, Press Release: *AT&T and eCardio Advance Cardiac Care with Mobile Technology*, http://www.att.com/gen/press-room?pid=18633&cdvn=news&newsarticleid=31268 (Oct. 7, 2010); Nicole Lewis, *AT&T, Vitality Offer Wireless Pill Caps on Amazon*, InformationWeek, http://www.informationweek.com/news/healthcare/patient/showArticle.jhtml?articleID=229000046 (Jan. 4, 2011).

[18] *See, e.g.*, AT&T, "Smart Grid Solutions from AT&T", http://www.wireless.att.com/businesscenter/promotions/industry/utilities-smart-grid-solutions.jsp (last visited Feb. 4, 2011).

While the Commission's flexible use policies provide the opportunity to innovate, the secondary markets rules provide the economic incentive to ensure that spectrum is being used to its fullest potential. Licensees have the ability to craft innovative business arrangements to move spectrum resources into the hands where they can be best used. The Commission's secondary market rules permit leases with a variety of duration or rights being transferred. In fact, as the Commission recognizes in the Notice, the secondary markets rules also permit parties to experiment with a wide variety of dynamic shared use models.[24]

To the extent that there is any spectrum capacity going unused in the commercial bands that could be put to more productive use, these policies already promote making such spectrum available. As Professors Gerald R. Faulhaber and David J. Farber point out, "cognitive radio . . . can certainly pay its own way; licensees (who are no doubt a profit-making bunch) will be happy to permit truly non-interfering uses for a competitively determined market price . . . . There is no reason that this particular technology should get a free ride on spectrum" through federal

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19 *See* AT&T, "AT&T Navigator", http://www.wireless.att.com/learn/ringtones-downloads/att-navigator.jsp (last visited Feb. 4, 2011).

20 *See* AT&T, "AT&T Mobile Broadband – PC Cards, Netbooks, Data Plans", http://www.wireless.att.com/cell-phone-service/specials/netbooks.jsp (last visited Feb. 4, 2011).

21 *See* AT&T, "Amazon Kindle 3G Coming to AT&T Stores Nationwide", http://www.att.com/gen/press-room?pid=19194&cdvn=news&newsarticleid=31643 (Feb. 28, 2011).

22 *See* AT&T, Press Release: *AT&T to Expand Tablet Portfolio with Samsung Galaxy Tab*, http://www.att.com/gen/press-room?pid=18485&cdvn=news&newsarticleid=31207 (Sept. 16, 2010).

23 *See* AT&T, "Machine-to-Machine", http://www.business.att.com/enterprise/Family/enterprise-mobility-enterprise/m2m_business/ (last visited Feb. 4, 2011).

24 *See* Notice, 25 FCC Rcd. at 16645-46 ¶¶ 38-39.

mandates."[25] Indeed, AT&T already employs cognitive radio techniques in its network that allow wireless base stations to sense and schedule traffic and thus achieve better efficiency. AT&T continues to work with standards bodies, such as the Third Generation Partnership Program ("3GPP"), to improve and extend the uses for these techniques. However, it bears stressing that these applications are only appropriate for licensed spectrum bands when under the fully coordinated control of the network. While cognitive radio technology holds potential for allowing a network operator to maximize the value of its own spectrum resource, third parties have no incentive to maximize the efficiency and value of the network as a whole nor do they have the ability to understand the ramifications of their spectrum usage on overall network performance.

Introduction of opportunistic devices into the licensed spectrum bands also will diminish the incentives of licensees to maximize efficiency. Under the current regime, licensees have strong incentives to experiment with and deploy increasingly efficient mobile broadband technologies as a way of satisfying, and potentially staying ahead of demand. If a carrier can provide equal or greater service using less than the entirety of its spectrum resources, presently the carrier is rewarded either by being able to expand its subscriber base or by having the option to monetize its excess capacity on the secondary markets. However, if uncontrolled opportunistic devices are introduced to the band, the efficient carrier is likely to have its excess capacity taken over by unaffiliated third party users. The consequence would be to penalize the most innovative and efficient users of radio spectrum.

Moreover, any analysis of interference cannot be static, as the levels of interference created and tolerated are subject to change as a result of advancements in technology. Although

[25] Comments of AT&T Inc., GN Docket Nos. 09-51, 09-157, Faulhaber & Faber Decl. at 21-22 (filed Sept. 30, 2009) ("AT&T CMRS Innovation Comments").

new air interfaces like LTE often provide increased spectral efficiency, they are also often more sensitive to interference or degradation than legacy systems. Uncontrolled dynamic use devices that do not interfere with current technologies may pose much greater problems as carriers upgrade their networks. In a scenario where any increased efficiencies in spectrum created as a result of technological advance are absorbed by third party devices, and licensed services operating over the new technologies are less able to coexist with proximate opportunistic devices, any incentive to develop new licensed wireless technologies is greatly diminished along with the innovations that those technologies make possible.

Moreover, the types of contention-based protocols envisioned under dynamic spectrum use are typically inefficient in those high density areas where spectrum is most needed. For example, at high levels of use, contention-based protocols can result in failure due to an exponential increase in the number of retransmits. Instead of permitting unfettered attempts by third parties (and mandated use by such parties), the Commission should continue to permit licensees of mobile spectrum to manage the use of their spectrum resources in the same manner that has driven the exponential growth of the wireless industry. Managed use—through a licensee—can be much more efficient in these situations.

B. Uncoordinated Dynamic Use is Technically Unfit for Licensed Mobile Bands.

As a technical matter, the ever evolving and intensely used licensed mobile bands are a poor choice for uncoordinated dynamic use because of the high number of variables, the heavy congestion, and the heightened susceptibility to harmful interference that characterize the commercial services deployed in these bands. The present proceeding was partially prompted by the National Broadband Plan's recommendation that the Commission spur further development

of opportunistic spectrum uses.[26] However, even the National Broadband Plan seemed to acknowledge that opportunistic use may be best suited to "frequency bands where the behavior of stations is well understood and predictable."[27] This clearly does not describe the licensed mobile spectrum bands, and Commission experience with dynamic spectrum use devices demonstrates their inappropriateness for uncontrolled use in licensed mobile spectrum.

The Commission's own testing of dynamic spectrum use devices in the TV bands revealed significant challenges with these devices, in terms of both accurately identifying channels that are available for use and adequately protecting licensed services from interference. When the Commission's laboratory division tested the spectrum sensing and transmitting capabilities of prototype TV band devices, it observed that "[a]ll of the devices reported some channels as occupied when the [TV band device] was operated outside of the service contours of stations broadcasting on those channels whether the signal was viewable or not."[28] More troubling from the perspective of an incumbent licensee, the Commission observed that TV band devices were capable of causing co-channel interference to DTV signal reception at distances of up to 360 meters.[29] It was these observations, in part, that led the Commission in 2008 to conclude that spectrum sensing technology was neither "sufficient by itself to enable unlicensed devices to reliably determine the TV channels that are available for use at a location," nor "to

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[26] *See* Notice, 25 FCC Rcd at 16638 ¶ 15 (*citing* Federal Communications Commission, *Connecting America: The National Broadband Plan*, Recommendation 5.13 (March 2010) ("NBP")).

[27] NBP, Recommendation 5.13 at 96.

[28] Steven K. Jones, et al., Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, *Evaluation of the Performance of Prototype TV-Band White Spaces Devices Phase II* at vii, FCC/OET 08-TR-1005 (Oct.15, 2008).

[29] *Id.*

adequately protect from interference television and other licensed services that use the TV bands."[30]

That dynamic use technologies are insufficient to adequately protect operations in the broadcast television bands is particularly telling because, in many ways, the broadcast television band is the "simple" case for policy-based sharing devices. The challenges in mobile bands are exponentially more complex, and the stakes are potentially much greater:

- There are a very discrete number of television broadcast facilities—approximately 9000, including LPTV stations.[31] According to CTIA, there were over 250,000 mobile cell sites in use as of June 2010 and more than 292 million mobile subscriber connections.[32]

- Television broadcast facilities are only rarely modified. In contrast, mobile carriers add base stations and modify their network topographies nearly constantly.

- TV broadcast facilities generally operate at very high power levels and the TV receivers require a good signal-to-noise ratio (or signal to interference-plus-noise ratio) to operate correctly. In contrast, the W-CDMA and LTE radio technologies can be successfully received when the signals are below the noise floor and so spectrum sensing devices may not detect the presence of these signals when close to a licensed receiver.

- Television broadcast stations are predominantly one-way transmitters meaning that the occupied channels are carrying transmissions at all time. Mobile systems, however, often use different spectrum bands for the uplink and downlink segments, meaning that cognitive radios may erroneously detect no activity in a portion of the band, notwithstanding the fact that a call is in session. And the parameters of mobile channel use are so quick – it would be extremely difficult for a sensing device to monitor and switch in rapid enough fashion to ensure that a mobile channel was not in use at a given time.

- Over 90 percent of television receivers actually obtain their signals from non-broadcast means, whether cable television or satellite; the number of television users

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30 2008 TV White Spaces Order, 23 FCC Rcd at 16836 ¶¶ 71, 73.

31 *See* Federal Communications Commission, News Release: Broadcast Station Totals as of September 30, 2010 (rel. Oct. 22, 2010) *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-302349A1.pdf.

32 *See* CTIA—The Wireless Association®, *U.S. Wireless Quick Facts*, http://www.ctia.org/media/industry_info/index.cfm/AID/10323 (last visited Feb. 3, 2011).

who rely on over the air broadcasts and live in marginal signal strength areas is very small. On the other hand, there over 292 million mobile users that all must obtain access from the wireless network.

- While the distribution of Emergency Alerts over broadcast television is undeniably important, in most cases the interruptions caused by debilitating interference to television systems can be overcome through other technologies and the emergency information can still be communicated. The same is not true of mobile services which are often an individual's only means of communication. Given the high percentage of 911 calls originating from mobile phones, interference to licensed mobile operations could affect the safety of life and property. Moreover, a great number of public safety agencies rely upon licensed mobile service devices to communicate.

The dynamic nature of network usage also makes mobile wireless systems unfeasible for cataloging through a station database, as contemplated in the TV bands. In light of the recognized difficulties and unproven viability of opportunistic devices in the TV bands, and the significantly more complex spectral environment of the license mobile bands, the Commission should recognize that, as a technical matter, dynamic use technologies must not be introduced to the licensed mobile bands outside of the close control and coordination of the licensee.

C. Permitting Dynamic Use in Licensed Mobile Spectrum Could Devalue Incumbent Licensees' Spectrum Rights.

Introduction of uncoordinated dynamic use technologies in the licensed mobile spectrum bands also could effect a potentially unlawful devaluation of incumbent licensees' spectrum rights. By essentially negating the exclusivity of their licenses and introducing new potentially interfering services into their bands, the Commission will devalue an investment by licensees that spent extraordinary sums of money in spectrum auctions to gain their spectrum rights, and much more to commercialize the licenses. In addition to being contrary to fundamental principles of equity, this devaluation of spectrum licenses may be legally infirm. At a minimum, the Commission exposes itself to legal challenges under the doctrine of regulatory takings, as having conducted an impermissible retroactive rulemaking, and for breach of contract.

If the Commission were to adopt rules enabling the use of opportunistic devices in the licensed spectrum bands outside of the control of the licensee, it could arguably constitute a regulatory taking without just compensation. A regulatory taking occurs when government action causes significant economic harm that interferes with settled, investment-backed expectations, particularly where the action is extreme and unjustified.[33] Each of the elements of a just compensation claim under the regulatory takings doctrine would appear to be satisfied if the Commission introduced uncoordinated dynamic spectrum use in the licensed mobile bands. The values placed on spectrum rights at auction by wireless carriers were set based upon clear service rules conferring exclusive flexible use of the frequencies. That the certainty, exclusivity, and flexibility of the rights conferred with a spectrum license has a direct impact on the value of the license at auction can be demonstrated by comparing the revenue generated by the auctions of the Lower 700 MHz Band C Block (710-716, 740-746 MHz) and the Upper 700 MHz Band B Block (704-710 / 734-740 MHz). In both cases twelve megahertz of paired 700 MHz spectrum was auctioned in the form of 734 licenses covering the entire United States. The C Block licenses, which were hampered by significant uncertainty regarding the rights of incumbent broadcasters and their migration out of the band, took three auctions to be fully sold and brought in a total of approximately $103 million in net bids.[34] By contrast, the B Block licenses, which enjoyed a perception of greater certainty with respect to the rights of incumbent broadcast

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[33] *See Penn Cent. Transp. Co. v. City of New York*, 438 U.S. 104, 124 (1978); *Ruckelshaus v. Monsanto*, 467 U.S. 986 (1984).

[34] *See* Lower 700 MHz Band Auction Closes, *Public Notice*, 17 FCC Rcd 17272, Attachment A (2002); Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873, Attachment A (2003); Auction of Lower 700 MHz Band Licenses Closes, *Public Notice*, 20 FCC Rcd 13424, Attachment A (2005).

licensees, raised over $9 *billion* in Auction 73—nearly 90 times the net bids for the almost identical Lower C Block spectrum.[35]

Wireless carriers not only spend millions of dollars on exclusive spectrum rights, but for years afterward structure their entire businesses around these reasonable investment-backed expectations. Networks have been constructed, devices designed, and binding commitments made based upon certain understandings of the amount of spectrum available to licensees and the specifics of the interference environments. Simultaneously, as discussed above, there is no evidence that substantial amounts of spectrum are going unused in these bands that could be rationalized by opportunistic devices. Under these circumstances, introduction of dynamic use to these bands outside of the close control of carriers would be both extreme and unjustified.

Moreover, introduction of uncoordinated dynamic spectrum use devices may be unlawfully retroactive. As the D.C. Circuit has explained, "we start from the intuitive premise that an agency cannot, in fairness, radically change the terms of an auction after the fact."[36] Allowing the operation of opportunistic devices in the licensed bands without the consent and control of the licensee would fundamentally change the basis on which the licenses were auctioned after fact. Despite being ostensibly forward-looking, courts consider such rules—which radically change the expectations on which past actions were taken—to be "secondary retroactivity," which is reversible error where the agency acts arbitrarily or unreasonably.[37] Here because of the substantial reliance upon their reasonable expectations over a course of years, and

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[35] *See* Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572, Attachment A (2008).

[36] *U.S. Airwaves Inc.* v. *FCC*, 232 F.3d 227, 235 (D.C. Cir. 2000)

[37] *See Celtronix Telemetry, Inc. v. FCC*, 272 F.3d 585, 589 (D.C. Cir. 2001); *U.S. Airwaves*, 232 F.3d at 233 (reviewing court must review such rules to see whether they are reasonable "both in substance and in being made retroactive").

the unproven nature of the benefits expected to be wrought by the change, the retroactivity would seem manifestly unreasonable.

Finally, the Commission's actions may constitute a breach of contract. Auctions in which carriers pay billions of dollars in consideration for spectrum licenses create contracts with the government, and radical regulatory changes that undermine the value of the licenses would constitute breach of contract.[38] Although it is clear that the winning bidder assumes a degree of risk with respect to future regulatory changes that may affect the contract, especially as it relates to changes of general applicability,[39] there is a line the government cannot cross. Post-contract Commission regulations aimed specifically at altering the defining characteristics of the spectrum it auctioned would, under any standard, constitute a material change in the bargain and expose the Commission to liability for breach.

Independent of any legal hurdles, the Commission should also recognize that, by devaluing exclusive use spectrum licenses, the Commission may negatively affect the ability of wireless carriers to obtain capital for deployment of next generation broadband systems, to the detriment of national broadband policy. Introduction of uncoordinated dynamic use would inject substantial uncertainty into the business models of wireless carriers. Capital markets are still recovering from the global financial crisis, and there is greater competition than ever among providers of innovative mobile broadband services. In this context, potential investors could be deterred both by the new challenges posed by the introduction of dynamic use and by the perceived decrease in value of wireless carriers' most significant assets. The result could be an

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[38] *Winstar* v. *United States*, 518 U.S. 839 (1996) (government may be liable for breach of contract caused by change in law by Congress).

[39] See *Celtronix*, 272 F.3d at 590; *see also In re NextWave Pers. Commc'ns*, 200 F.3d 43, 60-62 (2d Cir. 1999) (acknowledging that wireless auctions do create contracts).

inability to obtain capital on the most favorable terms, which could delay progress on carriers' plans for next generation mobile broadband deployment.

III. ALTERNATIVES EXIST THAT WOULD PERMIT DEPLOYMENT OF DYNAMIC USE DEVICES WITHOUT THREATENING CRITICAL SERVICES.

Substantial opportunities, in the form of unlicensed and Federal government spectrum bands and voluntary arrangements with existing spectrum users are already available for experimentation with dynamic spectrum use in ways that do not risk interfering with the licensed mobile services relied upon by public safety, utilities, the medical industry, and hundreds of millions of U.S. consumers. In considering the need for additional action to promote the development and adoption of these technologies, the Commission should consider these various options, each of which is preferable to the introduction of opportunistic devices in the licensed wireless bands.

In the Notice, the Commission expresses a desire to explore "opportunities for use of dynamic spectrum access techniques under both licensed and unlicensed regulatory approaches."[40] However, as discussed above, substantial public policy considerations counsel against introduction of these devices in the licensed mobile spectrum bands outside of the direct control of the licensee. Many of these same concerns do not apply in the unlicensed spectrum bands. Unlicensed bands are already subject to non-exclusive use and the devices and services deployed therein are typically optimized for operations in shared environments. Moreover, because these bands have not been subject to license auctions, the legal concerns surrounding a potential devaluation of the spectrum are also absent. The Commission should build upon the success it has already enjoyed with unlicensed, "licensed-lite," and other forms of shared use

[40] Notice, 25 FCC Rcd at 16639 ¶ 17.

outside of licensed commercial bands, and focus on deployment of dynamic spectrum use techniques in those bands.

Substantial spectrum is currently available for unlicensed devices or non-exclusive use. This includes the 902-928 MHz band, 1920-1930 MHz Unlicensed PCS band, the 2400-2483.5 MHz band, and the 5 GHz Unlicensed National Information Infrastructure Band. Add to this the 3650-3700 MHz "licensed lite" band, the more than 7 GHz of spectrum made available for ultra-wideband operations, and the ongoing development of TV band devices, and it becomes clear that the amount of spectrum available for unlicensed and non-exclusive use dwarfs the size of the exclusively licensed CMRS bands. Prior to considering experimentation with dynamic spectrum use devices in licensed bands, the Commission should exhaust the potential for deployment in these other bands.

Some dynamic spectrum use technologies, such as spectrum sensing, could also be particularly well suited to deployment in spectrum bands currently dedicated to Federal government use. Federal spectrum use is often highly localized around specific bases, offices, or other installations. As such, it is likely that some Federal spectrum bands are underutilized across many parts of the nation. However, it is essential that when the government does need to use the spectrum, it is able to do so without any impediments caused by secondary users. With appropriate further development, properly configured cognitive radios and spectrum sensing devices may have the potential to make more efficient use of underutilized Federal spectrum bands in the areas and at the times when Federal users are not occupying them. AT&T respectfully suggests that the Commission should explore further the possibility of coordinating with the National Telecommunications and Information Administration ("NTIA") on identifying

a Federal or shared band for the introduction of dynamic spectrum use technologies, as contemplated in the Notice.[41]

Finally, because of the Commission's flexible use and secondary markets rules, entities seeking to deploy services based on dynamic spectrum use can already seek voluntary arrangements with existing spectrum users, including Commission licensees and government users. As the Commission recognized in the Notice, "[u]nder these policies, licensees and spectrum lessees already have wide latitude to adopt and implement spectrum management techniques to manage access to and use of their spectrum, so long as that use is consistent with the applicable rules relating to the spectrum band and the prevention of harmful interference."[42] Under this regime, licensees and lessees are able to negotiate rights in a rational, market driven manner. Thus, to the extent that there are viable opportunities to make more efficient use of licensed spectrum, such arrangements can already be reached without the need for further Commission intervention.

IV. GREAT CARE SHOULD BE TAKEN WITH DYNAMIC USE DEVICES GIVEN THE PARTICULAR THREAT POSED BY UNAUTHORIZED USE.

The Commission should tread particularly carefully in exploring opportunities to expand deployment of dynamic spectrum use techniques because some of the very characteristics that are intended to make these devices capable of coexisting with incumbents' services also make them especially difficult to identify and shut down in the event of harmful interference. As the Notice recognizes, "[i]f the devices are dynamically changing their operating parameters, the transient interference makes it difficult to locate the devices that are the source of interference."[43]

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41 Notice, 25 FCC Rcd at 16647 ¶ 44.

42 *Id.*, 25 FCC Rcd at 16644 ¶ 36.

43 *Id.*, 25 FCC Rcd at 16643 ¶ 31.

If an opportunistic device outside of the control of a commercial network operator is causing interference to users of the licensed service, the network operator may have difficulty even identifying that the interference is coming from such a device, as opposed to another. Moreover, even upon identifying the source of interference as being a dynamic spectrum use device, because of the nomadic and decentralized nature of these devices, there may be no straightforward way to locate the device and prevent the interference from reoccurring.

AT&T notes that the potential for harmful interference is of particular concern with respect to "policy radios," which are dynamic devices operating pursuant to a set of rules intended to govern a range of devices. The threat here is that policies are not native to the device, and devices are likely to be inherently capable of operating pursuant to different sets of policies under different circumstances. As the policy rules may not be "hard-wired" into the devices, the potential exists for end users to modify the operations of the device, in contravention of accepted policies, in such a way as to pose a threat to licensed commercial users as well as government and public safety communications.

Although AT&T recognizes that locks or controls may be deployed to prevent such tampering, it is instructive that virtually every attempt to lock down consumer devices has eventually been circumvented. For example, copyright protection encryption built into consumer DVD and Blu Ray Discs have been completely nullified and pirates are now able to access the source code of these encrypted media at will.[44] Perhaps more relevant are the "hacks" that have

[44] *See* Sam Costello, *Seven Lines of Code Can Crack DVD Encryption*, PC World, http://www.pcworld.com/article/43943/seven_lines_of_code_can_crack_dvd_encryption.html (Mar. 8, 2001); Adrian Kingsley-Hughes, *Leaked HDCP Key is the Real Deal*, ZDNet, http://www.zdnet.com/blog/hardware/leaked-hdcp-key-is-the-real-deal/9729 (Sept. 17, 2010).

been used to "jailbreak" mobile phones,[45] modify video game consoles,[46] and unlock unauthorized functionality in e-readers.[47]

In many cases, widely available scripts allow unauthorized capabilities of consumer devices to be exploited by users without any degree of advanced understanding of the technology. This situation presents an even greater risk that not only will the policies be circumvented, but that these radios will be misused by technically unsophisticated consumers. The likelihood of circumvention of these devices combined with the difficulty in identifying them as causes of harmful interference makes for a serious threat that policy radios could cause significant harmful interference to commercial users and critical services. As such, AT&T cautions that any experimentation with policy devices must proceed very cautiously.

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45 *See* David Kravets, *U.S. Declares iPhone Jailbreaking Legal, Over Apple's Objections*, Wired, http://www.wired.com/threatlevel/2010/07/feds-ok-iphone-jailbreaking/ (Jul. 26, 2010).

46 *See* Alessondra Springmann, *New PlayStation 3 Firmware Hacked Within 24 Hours of its Release*, PCWorld, http://www.pcworld.com/article/218328/new_playstation_3_firmware_hacked_within_24_hours_of_its_release.html (Jan. 31, 2011).

47 *See* Alessondra Springmann, *Hack: Enable the Android Market on Your Nook Color*, PCWorld, http://www.pcworld.com/article/213446/hack_enable_the_android_market_on_your_nook_color.html (Dec. 13, 2010).

V. CONCLUSION

AT&T whole-heartedly shares the Commission's dedication to exploring every possible means for addressing the nation's growing need for additional spectrum to support wireless broadband services. Dynamic spectrum use technologies hold great promise to be an important part aspect of the nation's overall broadband strategy. However, because of the significant public policy concerns, the other viable alternatives, and the significant challenges posed by unauthorized use, these technologies are simply inappropriate for introduction into the licensed mobile spectrum bands outside of the control of the incumbent licensee.

Respectfully submitted,

AT&T INC.

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